BE| VIII | MECH| Finite Element Analysis

48 : 1st half.12-AM(w)

Con. 3613-12. (REVISED COURSE) 15/05/2012 **GN-7427**

(4 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from remaining **six**.
(3) Assume suitable **data** if **required**.
(4) **Figures** to the **right** indicate **full** marks.

1. Attempt any **four** of the following :—
   (a) Briefly explain application of FEM in various fields. 5
   (b) Explain Principle of minimum Potential Energy. 5
   (c) Explain different sources of error in a typical F.E.M. Solution. 5
   (d) Briefly explain Node Numbering Scheme. 5
   (e) Explain properties of Global Matrix. 5

2. (a) Solve the following differential equation using Galerkin's method 10

$3\frac{d^2u}{dx^2} - 3u + 4x^2 = 0$ with boundry conditions u(0) = u(1) = 0. Assume Cubic Polynomial for approximate solution.

   (b) Solve the following differential equation using Rayleigh - Ritz method 10

$3\frac{d^2y}{dx^2} - \frac{dy}{dx} + 8 = 0, 0 < x < 1$ with boundry conditions y(0) = 1 and y(1) = 2. Assume Cubic Polynomial for trial solution. Find the value at y(0·3) and y(0·8)

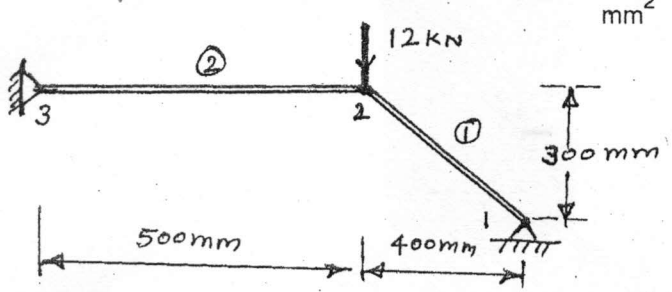
3. (a) Evaluate the following integral using Gauss Quadrature. Compare your answer with exact 12

$$I = \int_{-1}^{1}\int_{-1}^{1}\left(r^3 - 1\right)(s-1)^2 \, dr \, ds$$

n	ξ	w
1	0·0	2
2	± 0·5774	1
3	+ 0·0 ± 0·7746	0·8889 0·5556

   (b) Explain the following :— 8
   (i) Convergence requirements
   (ii) Global, Local and Natural co-ordinate system.

4. (a) For the two bar truss shown in **figure**, determine the nodal displacement; stresses in each element and reaction at support. Take $E = 2 \times 10^5 \frac{N}{mm^2}$, $A = 200 \text{ mm}^2$ 15



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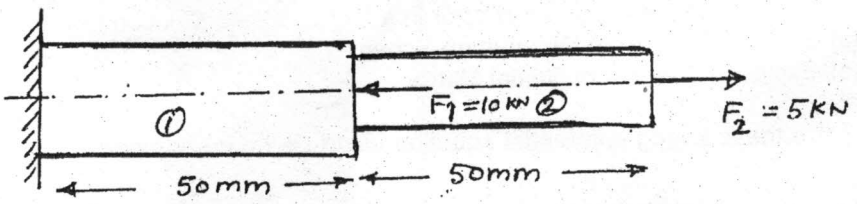
(b) Explain Band Width. 5

5. (a) Using Direct Stiffness method, determine the nodal displacements of stepped bar shown in **figure**. 12

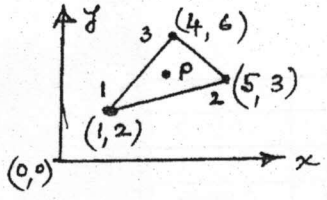


Take $E_1 = 200$ GPa $A_1 = 150$ mm^2 $F_1 = 10$ kN
$E_2 = 70$ GPa $A_2 = 100$ mm^2 $F_2 = 5$ kN

(b) Derive the shape function for a Quadratic bar element [3 noded 1 dimensional bar] using Lagrangian Polynomial in (i) Global co-ordinates and (ii) Natural co-ordinates. 8

6. (a) Find the shape function for two dimensional Nine noded rectangular elements mapped into natural coordinates. 12

(b) The nodal co-ordinates of a triangular element are as shown in **figure**. The x co-ordinate of interior point P is 3·3 and shape function $N_1 = 0{\cdot}3$. Determine N_2, N_3 and y co-ordinate of point P. 8



7. (a) Find the natural frequency of axial Vibrations of a bar of uniform cross section of 20 mm^2 and length 1 m. Take $E = 2 \times 10^5 \frac{N}{mm^2}$ and $\rho = 8000 \frac{kg}{m^3}$. 10

Take 2 linear elements

(b) Discuss briefly higher order and isoparametric elements with suitable sketches. 10